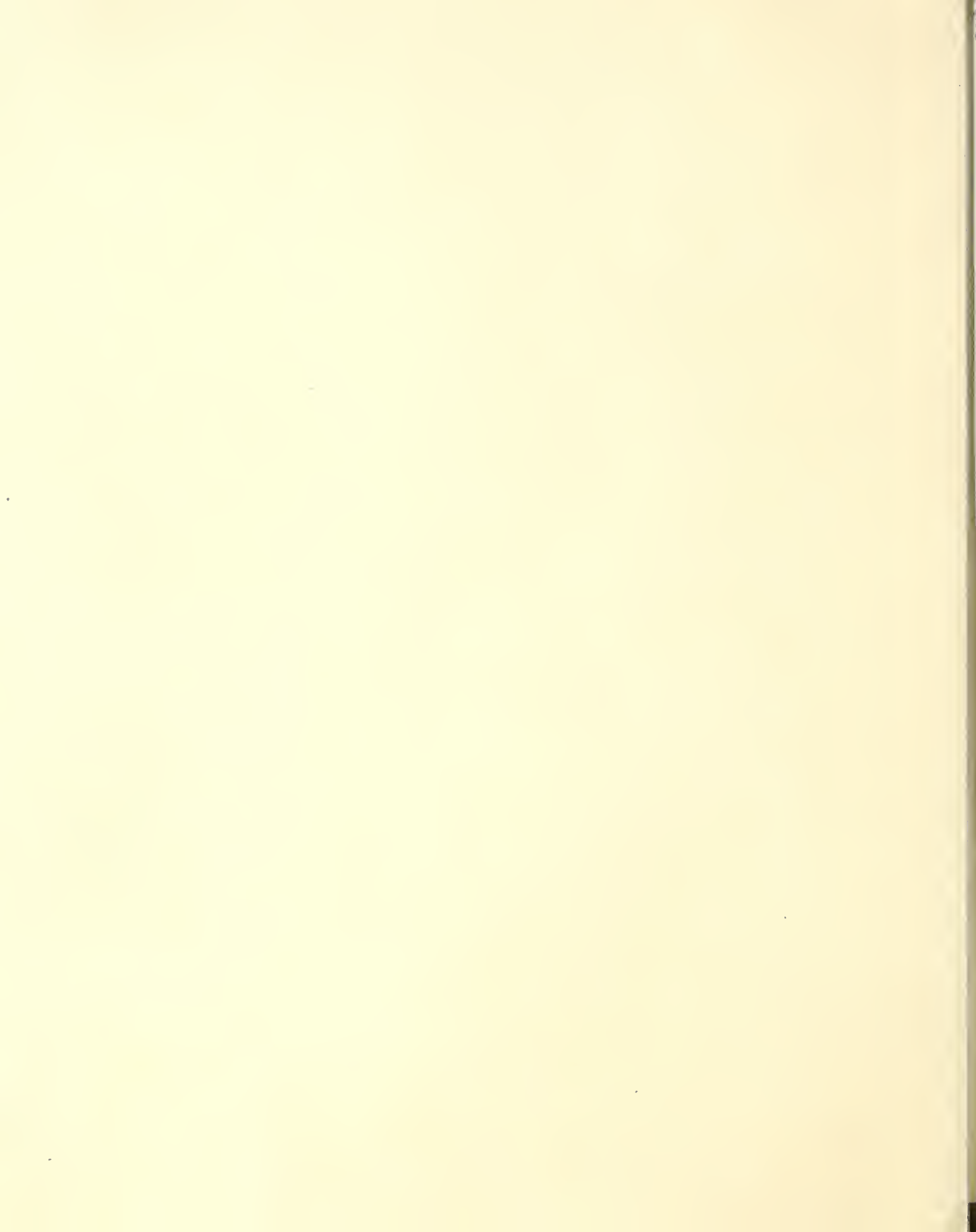


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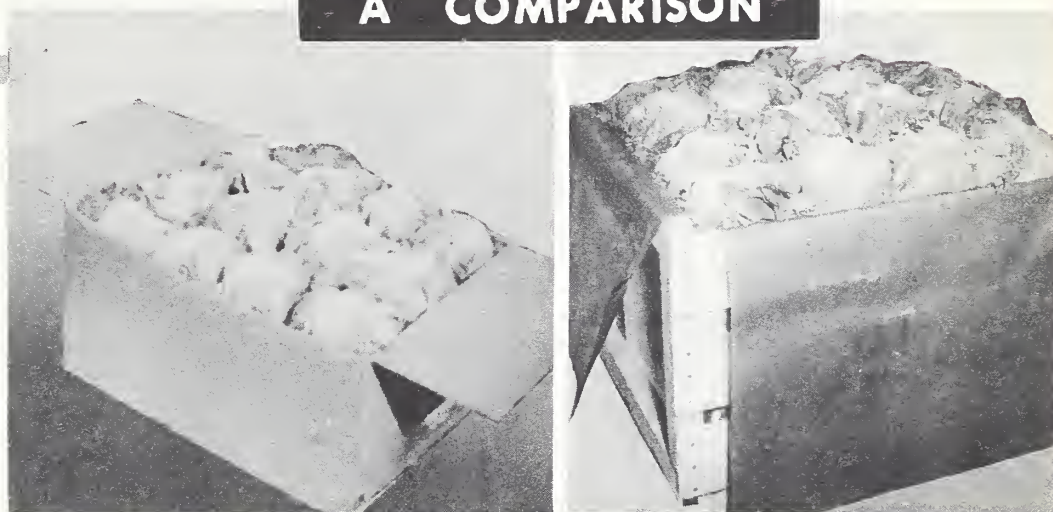
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# PACKING AND SHIPPING LETTUCE *in* Fiberboard Cartons *and* Wooden Crates

**A COMPARISON**



**Marketing Research Report No. 86**

**U. S. DEPARTMENT OF AGRICULTURE  
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## ACKNOWLEDGMENT

This is one of a series of reports issued by the Agricultural Marketing Service, U. S. Department of Agriculture, resulting from studies of improved and less costly methods of shipping various agricultural products.

The study on which this report is based was carried out by the Western Growers Association, Los Angeles, Calif., under contract with the U. S. Department of Agriculture. The work was performed under the direction of F. W. Castiglione, Assistant Director of the Association, and J. C. Winter, of the Transportation and Facilities Branch, AMS, who supervised the contract.

Special credit is due to William R. Black, of the Association, for his work in supervising the inspection of test shipments of lettuce upon arrival at eastern markets and in the furnishing of related data upon which that part of the report is based.

Appreciation is expressed to the many shippers who made their records available in order that field and shed packing costs might be obtained and who provided the cars of lettuce on which the transportation tests were conducted.

\* \* \* \*

This study was made under authority of the Agricultural Marketing Act of 1946 (RWA, Title II).

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## SUMMARY

A survey of harvesting, packing, and shipping costs for the 1952-53 lettuce harvests in California and Arizona disclosed that substantial savings were realized by dry-packing lettuce in fiberboard cartons in the field or packing sheds and vacuum-cooling it for shipment, as compared with ice-packing WGA crates in packing sheds. Although part of the savings realized through dry-packing fiberboard cartons in the field or packing sheds or dry-packing WGA crates in the field was absorbed by the higher costs of refrigeration required by the dry-packed commodity in transit, there remained a substantial net saving for the shippers in overall packing and shipping costs.

For the same quantity of lettuce (4 or 5 dozen heads), the overall net savings was 25 cents, or \$80 per car, when fiberboard cartons were dry-packed in the field and vacuum-cooled for shipment from the Imperial Valley to New York, N. Y., compared with WGA crates ice-packed in the packing shed. When cartons dry-packed in the field were cooled in the refrigerator car by use of the car fans and bunker ice, the comparable savings on New York shipments amounted to an average of 47 cents per 4 dozen or 5 dozen heads, or \$150.40 per car. The comparable savings on shipments from the Imperial Valley and other producing areas in California and Arizona to St. Louis, Mo., and other midwestern markets are somewhat greater than on shipments to New York City and other eastern markets because of the lower refrigeration costs on shipments to the Midwest.

In previous years nearly all the lettuce packed for rail shipment from California and Arizona was harvested and trucked to centrally located packing sheds, where it was packed into wooden crates with crushed ice. The crates were then loaded into refrigerator cars and additional crushed ice was blown over the load. The development of the vacuum-cooling process and the subsequent introduction of fiberboard cartons for lettuce containers have made it possible to dry-pack lettuce in cartons or crates in the field or shed without ice in the packages.

The cost of shed-packing lettuce in WGA crates with ice exceeded the average cost of field-packing the same quantity in fiberboard cartons by \$0.50, or 29.4 percent, in the Salinas-Watsonville district in 1952, and \$0.32, or 17 percent, in the Arizona-Imperial Valley area. Most of the economies realized in dry-packing fiberboard cartons in the field, as compared with ice-packing WGA crates in packing sheds, resulted from lower costs for containers and container components, lower labor costs for packing, handling, and loading, and lower overhead costs for facilities and equipment.

Transportation and storage tests conducted during the winter and spring months of 1953 revealed that lettuce shipped in these tests in cartons dry-packed in the field suffered substantially less bruising and decay than lettuce of comparable size and quality ice-packed in WGA crates. Inspection upon arrival showed that in the WGA crates 4.97 percent of the heads were seriously damaged by bruising and decay, compared with only 1.6 percent of the lettuce packed in cartons. After a 48-hour storage period to simulate marketing holding conditions, 32 percent of the heads in the WGA crates were seriously damaged by bruising and decay, compared with 17 percent of the heads in the fiberboard cartons. Additional information is needed, however, to compare the arrival condition of dry-packed, vacuum-cooled lettuce with that in ice-packed WGA crates during the hot summer months when conditions may be less favorable for dry-packed lettuce.

The most economical method of harvesting and packing for shipment was found to be field dry-packing of fiberboard cartons cooled by car fans in bunker-iced cars, but no study was made of the arrival condition of lettuce cooled by this method. It was used only in the desert area of southern California and Arizona, where early morning field temperatures of the lettuce at time of harvest are comparatively low.

# PACKING AND SHIPPING LETTUCE IN FIBERBOARD CARTONS AND WOODEN CRATES--A COMPARISON

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## INTRODUCTION

Until a few years ago, practically all lettuce harvested in the desert areas of southern California and Arizona during the winter and spring and in the Salinas-Watsonville area of California during the summer and fall was packed in large packing sheds. For many years the *Los Angeles crate* was the principal shipping container. It was supplanted by the *WGA crate* in 1951. Both of these containers were of sawed and nailed construction and accommodated either 4 or 5 dozen heads. Crushed ice between layers of lettuce in the crates, with top ice applied over the load of crates in the railroad refrigerator car, was the principal means of refrigeration.

Building of vacuum-cooling plants in the various producing areas to flash-cool the lettuce and the subsequent introduction of the fiberboard carton as a lettuce container have brought extensive changes. Now a high percentage of the lettuce grown is dry-packed in cartons in the field and cooled by placing the field-packed containers in a vacuum tube until the temperature of the lettuce has been lowered to 35° F.

A small percentage of the lettuce shipped from the desert areas is dry-packed in crates and top-iced only. This method of packing and shipping is confined mostly to shipments destined for local markets.

Some lettuce in cartons is shipped out of the desert areas during the winter months in cars that are fan-cooled before transportation begins. Part of this moves all the way to the East Coast.

In the Salinas-Watsonville area, field temperatures are usually high during the harvesting season, so the lettuce moving beyond local markets is either ice-packed or vacuum-cooled.

The purpose of this study is to compare in some detail results of the use of the two principal methods of packing and shipping lettuce: (1) Shed ice-pack of 4 or 5 dozen heads, and (2) field dry-pack in cartons of 2 or 2½ dozen heads, vacuum-cooled. Although there are several other variations, this study is confined to these two most widely used methods of packing.

Costs of growing lettuce are not included in this study. It is assumed that these costs are not affected by the packing method or container used for shipment.

There are three major lettuce-growing districts in California and Arizona, besides some minor producing areas. Lettuce grown in the Salinas-Watsonville area and the Santa Maria-Guadalupe area <sup>1/</sup> of California is harvested and shipped during the late spring, summer, and early fall months. In the desert districts of Arizona, including the Yuma and Phoenix areas, and the Imperial Valley of southern California the crop moves during the winter and early spring. These areas are far apart geographically, and differ in the duration of the shipping season and other characteristics, which influences costs. Therefore, in this study, two groups of cost figures are used as being representative of those prevailing in the two major producing areas--one for Imperial Valley-Arizona, and the other for Salinas-Watsonville.

## METHODS OF HARVESTING, PACKING, AND SHIPPING LETTUCE

### Types of Containers Used

About 40 percent of the lettuce shipped from the Imperial Valley of California during the winter of 1952-53 was dry-packed in the field. Most of this lettuce was packed in the No. 7300 carton. A small volume of dry-pack lettuce was shipped in WGA crates, but shipments of field dry-packed half crates were very light.

The remainder of the shipments from the Imperial Valley were shed-packed, mostly in WGA ice-packed crates. Some half crates were ice-packed and a very few dry-packed in the sheds. Many shippers packed cartons in the shed on order from a receiver if they did not have a field dry-pack operation.

Although field-packing was not as extensive during the spring deal in the Salinas-Watsonville area as in the desert district, the quantity increased as the season progressed and by late June about one-third of the total lettuce shipments from this area was field-packed, mostly in the No. 7300 carton.

The remaining two-thirds of the lettuce from the Salinas-Watsonville area was packed in sheds. Most of it was ice-packed in the standard 935-WGA crate and the 935-MC (SW) crate. The latter is a variation of the WGA crate; it has the same depth and width, but is 1 1/4 inches longer.

As the primary purpose of this study was to compare the field-packed carton and the ice-packed crate, the rest of this report will discuss the standard 935-WGA crate and the No. 7300 carton.

The dimensions and capacities of the principal containers used for lettuce during the study are shown in table 1.

During the midsummer 1953 season in Salinas-Watsonville, a half crate based on the 935-MC length was introduced and used by a few shippers.

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<sup>1/</sup> These two producing areas are often collectively referred to as the coastal producing district of California.

Table 1.--Dimensions and capacities of containers used in shipping lettuce from California and Arizona

Container designation	:	Inside dimensions in			:	Usual number
1/	:	inches			:	of heads
	:	Depth	:	Width	:	Length
	:	<u>Inches</u>	:	<u>Inches</u>	:	<u>Inches</u>
	:		:		:	
935 (WGA) crate	:	14 1/4	:	18 1/4	:	20 1/2
	:		:		:	4 or 5 dozen
935 MC (SW) crate	:	14 1/4	:	18 1/4	:	21 3/4
	:		:		:	4 or 5 dozen
409 M half-crate	:	9	:	14 1/4	:	21 5/16
	:		:		:	2 or 2 1/2 dozen
408 two-thirds crate	:	9	:	18 1/4	:	20 5/8
	:		:		:	32 or 40 heads
7300 carton	:	9 1/2	:	13 1/2	:	20 1/2
	:		:		:	2 dozen
85-505 carton	:	9	:	14 1/2	:	21 5/16
	:		:		:	2 dozen
7301 carton	:	9	:	13	:	21 5/8
	:		:		:	2 1/2 dozen

1/ Numbers used for container identification in Freight Loading and Container Tariffs.

### Harvesting and Hauling to Packing Sheds

The increased use of the fiberboard carton as a lettuce container and of vacuum-cooling in place of crate ice to lower the temperature of the lettuce has changed field harvesting methods, and, in many areas, shed-packing procedure. The conventional harvesting and packing practices are used where lettuce is ice-packed in crates in the packing sheds. But some sheds have included the dry-packing of cartons with the ice-packing of crates in the same packing line.

Most of the larger packing sheds are located close to the harvesting area and where ice plants, container supplies, and railroad facilities are available. The sheds were constructed to make ice-packing of the crates and loading of the cars rapid and easy. The lettuce is usually hauled from the fields to the packing sheds in large field baskets carried on trucks or trailers, or in bulk in gondola-type trailers.

In harvesting operations in the Salinas-Watsonville area, baskets are commonly used in conjunction with mechanical loaders. The cutting crew moves down the rows behind the loader and places or tosses the heads onto the conveyor belt (fig. 1). The conveyor belt carries the lettuce up and dumps it into the baskets on the truck or trailer, which moves alongside the loader. When all the baskets on one truck are full, the truck moves away and another truck moves under the loading chute. Two or three trucks with baskets are used with each mechanical loader, depending upon the distance from the field to the packing shed, which may be as much as 40 or 50 miles. Upon arrival at the shed, the baskets are



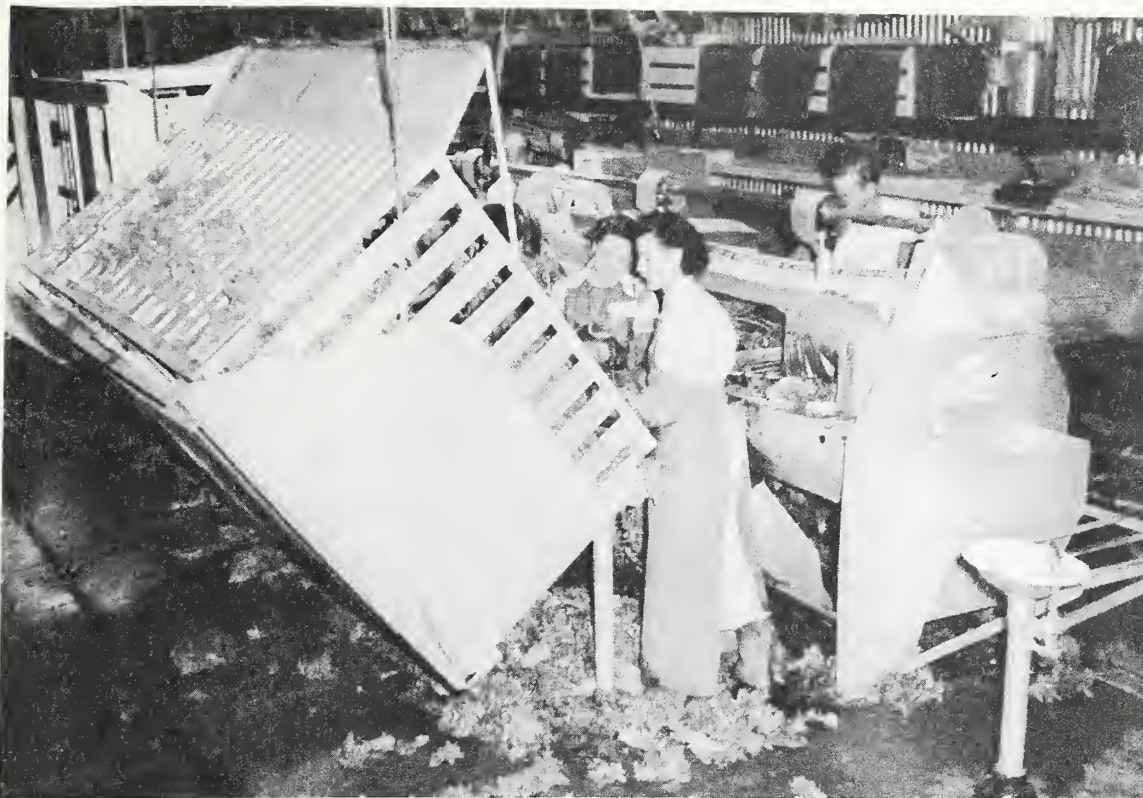
*Figure 1.--Mechanical lettuce loader and cutting crew at work in field. This device is moved through the field just ahead of the cutting crew that cuts the heads and places them on the conveyor belt, which moves the lettuce to the field baskets on truck at far right.*

removed from the truck or trailer to the shed floor, and are wheeled to the trimming line as required. At the line the baskets are tilted so that a steady supply is available to the trimmers on the packing line (fig. 2). As the baskets are emptied, they are replaced with full ones.

In the desert valley areas, the trailer method is used extensively. After the heads of lettuce are cut, they are tossed into the open trailer (fig. 3), which is towed to the shed when it is full. Upon arrival, the lettuce is dumped onto a draper <sup>2/</sup> which carries the lettuce directly to the trimmers (fig. 4). Some sheds use a conveyor belt, which moves above the trimming line. An angled board, called a plow, moves in the opposite direction and pushes the lettuce from the conveyor belt to the trimming table below.

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<sup>2/</sup> A draper is an inclined moving platform of narrow wooden slats attached to geared chains.



*Figure 2.--Field basket being emptied at trimming line. Baskets are tilted by overhead hooks so that trimmers can reach all heads in basket without much difficulty.*

### Shed-Packing Procedure

At the trimming line, loose, damaged, and wilted leaves are trimmed from the heads. Women usually do the trimming, and two floor men handle the baskets for the trimmers, keeping them supplied with lettuce. Troughs or conveyor belts carry the discarded lettuce away from the trimming line and trucks haul it from the shed. There are 2, 3, or 4 trimmers to each packer. One of the trimmers operates the mechanism that dumps the field baskets.

The trimmed heads are placed on a packing table or on a revolving wheel, from which the packer removes them and packs them in the container.

When lettuce is packed in a shed, the common practice is to ice-pack 4 or 5 dozen heads in wooden crates, although lately some half crates (24 or 30 heads) and two-thirds crates (32 or 40 heads) have been used. A few shippers also pack lettuce in cartons without ice on the same line. In the standard crate the lettuce is placed in 3 layers, with about 10 pounds of ice on top of each. Half and two-thirds crates have only 2 layers. Those containers are not included in the study and will not be referred to further.



*Figure 3.--Trailer method of harvesting lettuce. After the trailers are loaded, they are hauled to the packing shed where the lettuce is trimmed and packed.*



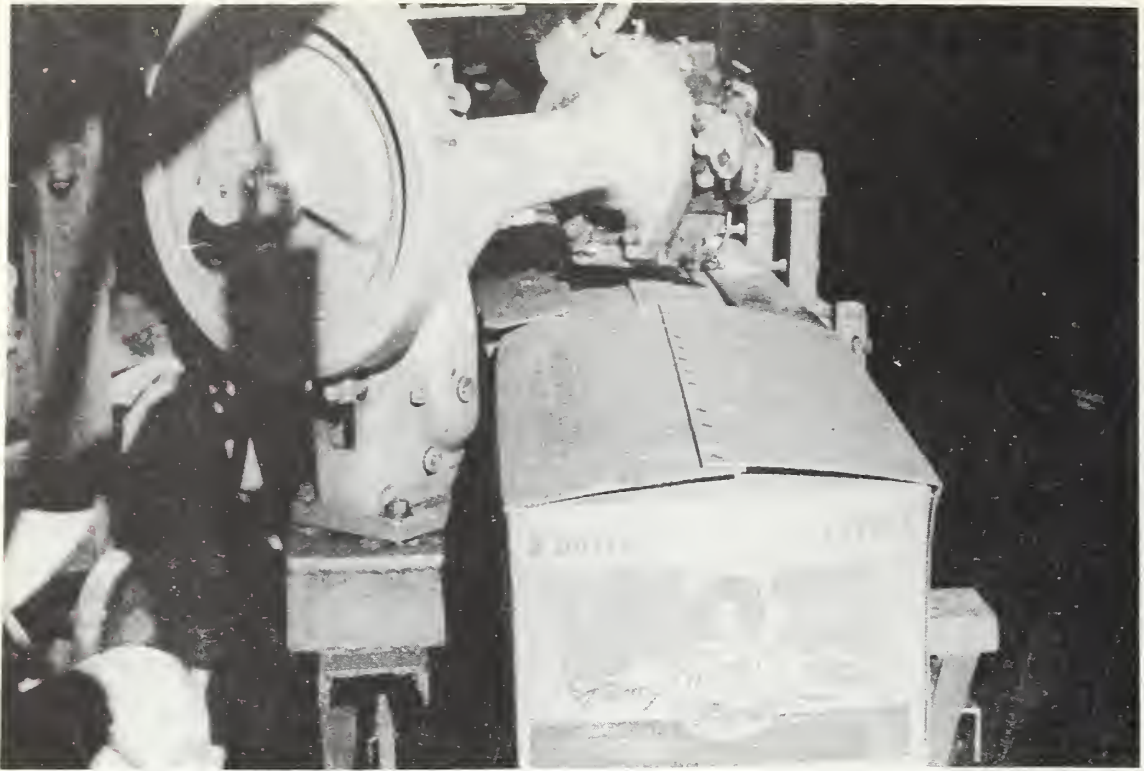
*Figure 4.--Dumping lettuce from field trailers onto draper in packinghouse. The workers in the background are trimmers who strip most of the outer wrapper leaves from the heads preparatory to packing.*

If both cartons and crates are packed in the same shed, both kinds of containers when packed are placed on the same conveyor and moved to the lidding or cover-stitching machines (fig. 5). The ice-packed crates usually follow the conventional shed operations, but one extra man is needed to turn the packed carton toward the stitching machine. If hand flap stitchers are used, one man feeds the cartons and another man works the carton clamp or shaper and stitches the top flaps. An automatic stitcher requires only one man to feed the cartons into the machine (fig. 6). After being stitched, the cartons are moved by conveyor to the truck dock for loading and are transported to the vacuum-cooling plant.



*Figure 5.--Dry-packing fiberboard cartons and ice-packing WGA crates in same shed. Made-up, or assembled, cartons are received on conveyor at upper left and trimmed heads on conveyor at lower left. Made-up crates are received on conveyor at upper right and the packed containers, both cartons and crates, are placed on conveyor at lower right for movement to the lidding or cover-stitching machines.*

In all the loads of nailed wooden crates, the containers are placed on their sides, lengthwise of the car. Two loaders are used for each car if crates are moving fast. The number of crates loaded in a car varies with the type of crate and the loading arrangement used. In each case, wooden 1- by 4-inch or 2- by 4-inch boards are used to brace and take up the lengthwise slack in the loads.



*Figure 6.--Fiberboard cartons passing through automatic cover flap stitcher.*

In top-icing the car at a large shed, one man operates the ice crusher and one uses an ice blower to force the crushed ice between the loaded crates in the car and over the load. The amount of top ice used depends on the season of the year and the destination of the car. During the desert winter deal, a common practice is to apply 15,000 pounds of top and channel ice to a load of ice-packed crates. Some shippers use 20,000 pounds of top ice on dry-packed crates. During the warmer months, 20,000 pounds is the standard amount of top ice for carloads of lettuce either ice-packed or dry-packed in crates.

#### Field Dry-Packing

Relatively little field dry-packing was done prior to the introduction of vacuum-cooling and the fiberboard carton. Before that time, the field-packed lettuce was cut during the cool early morning hours and packed in wooden crates. The dry-packed crates were loaded, top-iced, and shipped by rail or truck, mostly to local western markets. Recently, various types of portable field-packing equipment have been built to increase the packing speed with relatively small crews.

Several of the larger field packers and shippers use very little equipment in their field-packing operations. One such operation uses 1 truck in the field equipped with 2 carton-stapling or -stitching machines with 2 operators to assemble the cartons (fig. 7). A third man folds the carton for both stitching machines. The stitcher applies 4 to 8 staples



*Figure 7.--Making up and distributing cartons in the field for field-packing of lettuce. Carton blanks, which are stacked at front and rear of truck, are assembled by stapling the bottom flaps on two machines at middle of truck bed, and are distributed on both sides of truck as it moves through field.*

at each end of the carton. The made-up carton is tossed to the ground from the moving truck or placed on a wire chute that spaces a row of cartons on the ground in front of the packers. Each stitcher can average 400 to 450 cartons per hour. Some shippers buy the cartons already assembled instead of using stitching machines in the field.

Trimmers follow the rows of prepared containers and cut, inspect, and trim off diseased or wilted outer wrapper leaves. Trimmed heads are placed butts up at the side of the furrow. There are 3 or 4 trimmers for each packer, depending on the quality of lettuce. The packers follow behind the trimmers with small metal packing stands that avert excessive stooping by the packers and help to keep the containers in shape while they are being packed (fig. 8).

The 2-dozen size pack in the carton has 2 layers of 12 heads each. The bottom layer is packed with butts down and the top layer with butts up. The packer removes the packed carton from his stand and places it on even ground. A man with a carton clamp presses the top flaps together and a second man with a hand stapler inserts 4 or more staples to secure the cover flaps (fig. 9). After they are stapled, the packed cartons are picked up and loaded on trucks that follow close behind the packers.



*Figure 8.--Field-packer completing packing of fiberboard carton on portable packing stand.*

When a special machine is used for packing crates or cartons the number of packed-out cartons or crates per man is increased (fig. 10). A typical labor crew for such a machine is composed of:

- 16 men cutting, trimming, and picking up lettuce
- 8 packers
- 2 men on the stitching machine
- 1 rig driver
- 2 men to load crates or cartons on the truck
- 1 field boss

Total 30 men

The cutting and trimming for machine-packing is the same as for other methods of field dry-packing. As the dry-pack machine moves over the trimmed lettuce, trimmed heads are picked up and placed on a packing platform on the moving machine. The lettuce packers riding on the machine select and pack either 2 or 2½ dozen heads in the cartons, and the packed container is placed on a conveyor that moves toward the stitching machine. After the closing operation, the containers are placed on a moving truck to be carried to the vacuum-cooling plant or refrigerator car. Most of the field-packed lettuce is vacuum-cooled. As the loaded truck pulls away from the conveyor, an empty truck takes its place.



*Figure 9.--Closing and stitching cover flaps of fiberboard cartons in field with carton clamp or shaper and hand stapler.*

### Vacuum-Cooling

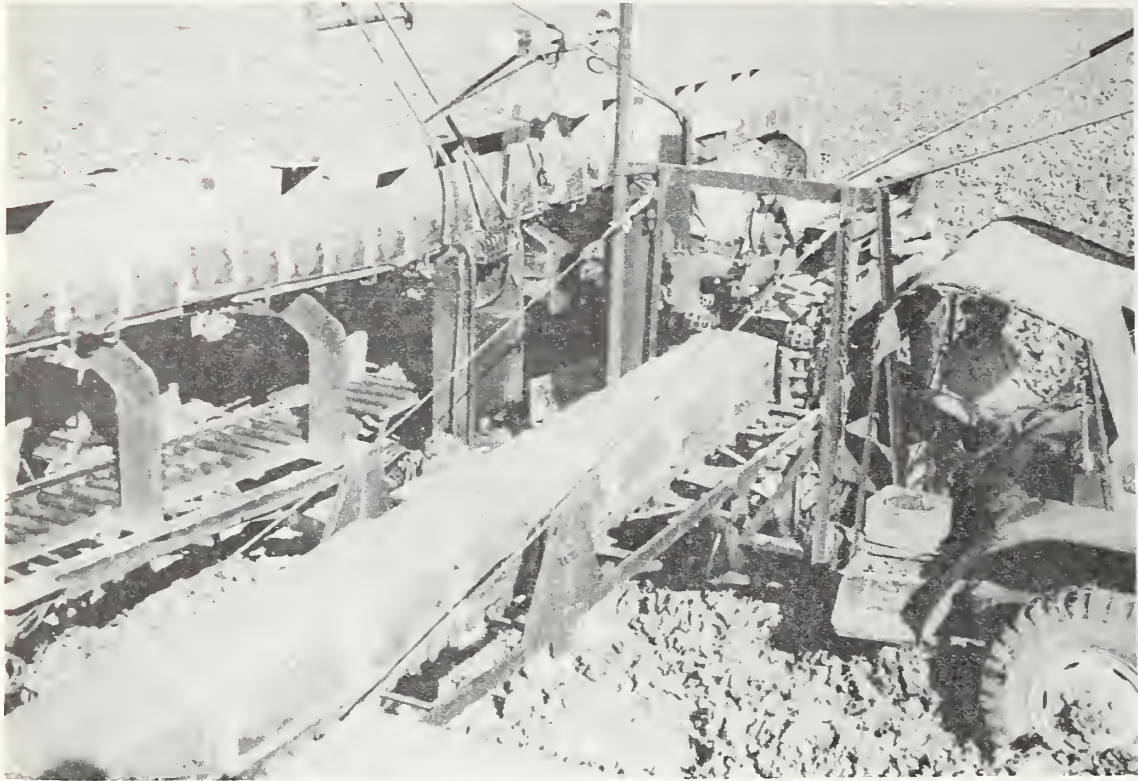
Although there are several variations of cooling lettuce by vacuum, all methods operate on the same principle. A vacuum is created in a large metal chamber, or tube, by use of either steam or electric pumps. This causes rapid evaporation of moisture, which lowers the temperature of the lettuce to a desired level of 33° F. to 35° F. within 20 to 30 minutes.

The factors that influence the time required to create the vacuum in the chamber and to cool the lettuce properly are:

- (1) Outside temperature and the moisture content of the air
- (2) Leafiness, temperature, and moisture content of lettuce
- (3) Amount of space between heads in the container

Warm, dry lettuce takes longer to cool. Cartons with overlapping top flaps require a longer time to cool than cartons which have some space between the top flaps.

Handling the lettuce before, during, and after cooling is much the same at the various vacuum-cooling plants. The vacuum-cooling company furnishes pallets on which the cartons are placed when the trucks are loaded in the field. They are unloaded at the

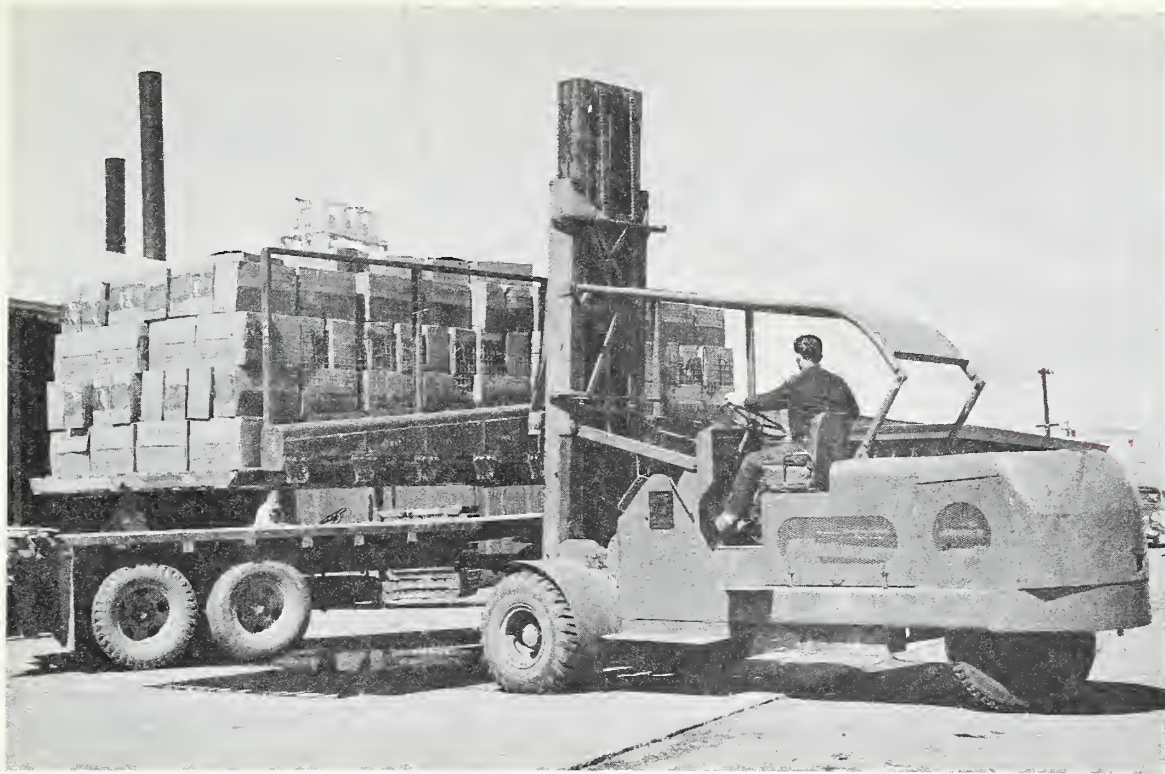


*Figure 10.--Dry-packing and closing covers of fiberboard cartons on mobile field packer.*

cooling plant dock by forklift equipment. At one of the larger plants, forklift equipment is available to remove an entire truckload of cartons or crates in one operation (fig. 11). The pallets of lettuce are carried into the warehouse and the truckload is placed in a block near the cooling tubes, or, if the warehouse is full of containers, it is deposited nearby to await its turn to be cooled. During operating hours, the flow of containers through the tubes is usually continuous. First loads in from the fields are the first to be cooled. A clerk checks the loads as they arrive at the cooling plant and records the approximate time that each load will enter the cooling chamber. The carloading clerk also checks the time each load enters and the shipper's name so that a rail car is available at the loading dock when the containers are removed from the chamber.

When preparing for the cooling of a load of lettuce, a long, narrow dolly is pushed into place in front of the loading end of the cooling chamber. The dolly is flat, wide enough to hold a single line of pallets, and approximately 40 feet long, only slightly shorter than the vacuum chamber. Forklift trucks place the loaded pallets on the dolly, which can hold slightly more than half a carload of lettuce containers. As soon as the chamber is clear of the previous load a small forklift truck pushes the loaded dolly into the chamber for cooling (fig. 12).

The operator of the cooling chamber places thermocouples in several lettuce heads in various containers before the doors are lowered and the cooling starts. When the



*Figure 11.--Large forklift truck unloading entire truckload of field dry-packed lettuce in fiberboard cartons on pallets at vacuum-cooling plant.*

temperature chart reads 33° F. to 35° F., the vacuum is released and the dolly is removed through the end of the chamber opposite from which it entered. The cooled containers are then removed from the dolly and placed on a conveyor that carries them to the refrigerator car for loading.

Vacuum-cooled lettuce is loaded in the cars by the cooling company. A car can be loaded in 20 to 30 minutes if a steady supply of cartons is maintained.

#### Fan-Precooling

In the desert areas, several companies use fans to cool lettuce in cartons or crates in railroad cars before transportation begins. The interiors of some cars are lined with paper. Bunkers are always pre-iced, and 2 percent of salt is usually added to the ice. Portable electric motors run the bunker fans until train-moving time (fig. 13). In some loads one or two 8-foot car strips are placed on each layer of each stack, depending on the instructions of the shipper. This method of cooling was used by several shippers in the desert areas where the field temperature of the lettuce was relatively low at the time of harvesting. No attempt was made in this study to determine how much the temperature of the lettuce could be lowered by this method. However, the general practice is to cool the loads about 8 to 12 hours before the car moves, lowering the temperature of the lettuce to 38° to 40° F. The amount of cooling required to obtain these desired commodity temperatures in the load depends upon the amount of field heat remaining in the lettuce at the time it is loaded into the car.

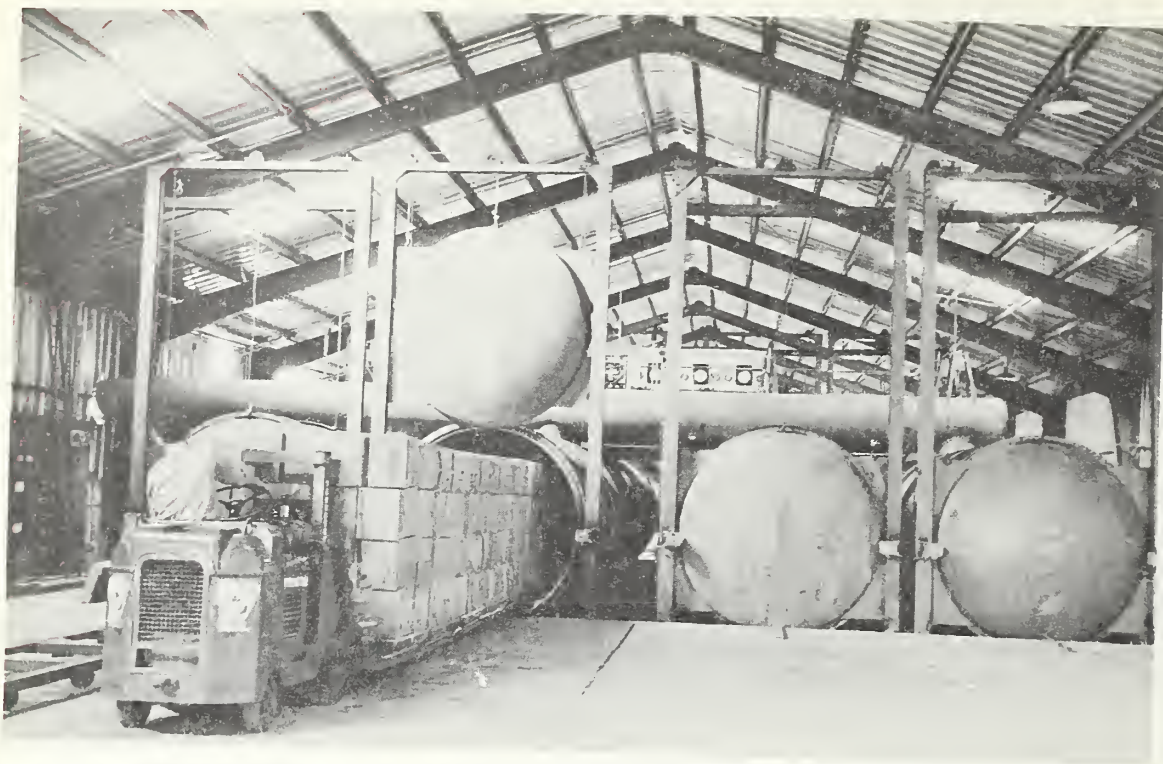


Figure 12.--Field dry-packed lettuce in fiberboard cartons stacked on a dolly being pushed into a vacuum-cooling tank. The lot of lettuce previously cooled in an open tank has been removed from the far end.

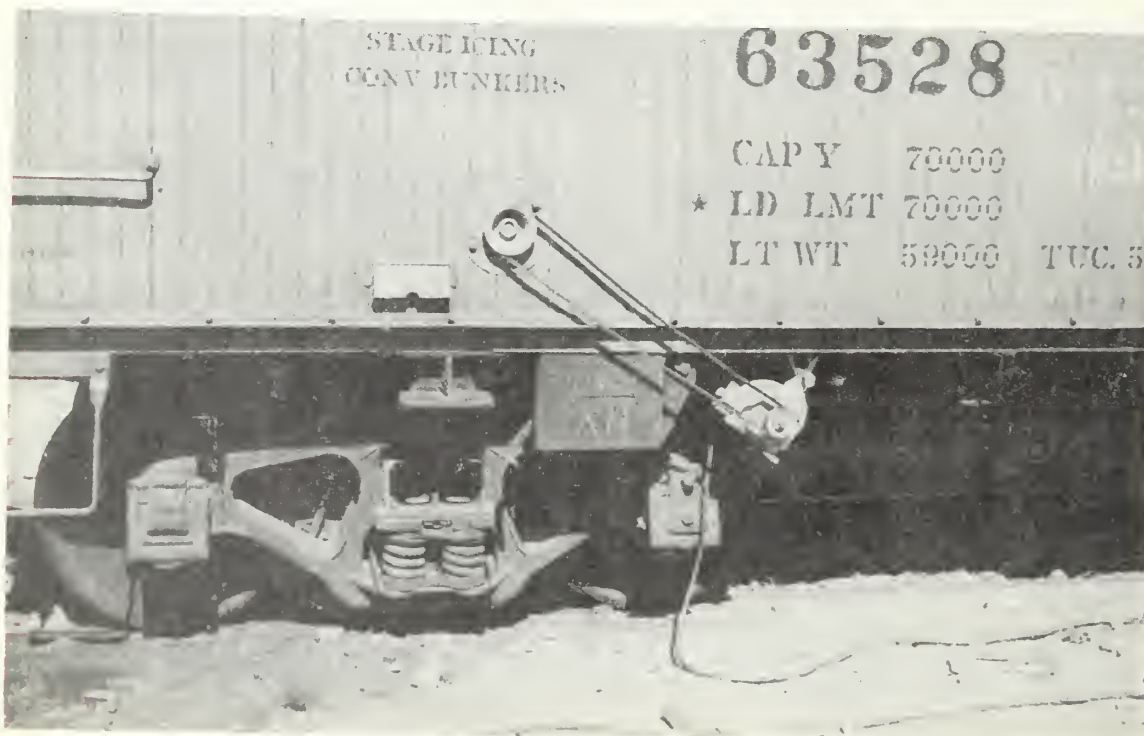


Figure 13.--Portable electric motor attached to side sill of refrigerator car for driving air-circulating fans inside car to cool lettuce before shipping.

## SHIPPER COSTS FOR VARIOUS TYPES OF CONTAINERS AND PACKING METHODS

### Ice-Packing WGA Crates in Packing Sheds

The predominant method of packing lettuce in sheds involves the use of WGA wooden crates, packed with 4 or 5 dozen heads each, with crushed ice in the crates and blown over the top of completed carloads. Costs for this type of operation were obtained from shippers in the Salinas-Watsonville area, Yuma and Phoenix, Ariz., and the Imperial Valley of California.

As the lettuce is harvested in the field and transported in bulk to the packing sheds by several methods previously described, the cost of haulage is included in the harvesting operations. The costs of trimming and packing the lettuce, and of loading and icing the crates in the cars are included in packing-shed expenses. The selling and general administrative expenses are kept separate from harvesting and packing costs and are usually not affected to any great extent by the type of harvesting and packing operation employed by the shipper.

Accounting practices of lettuce shippers do not differentiate between costs of 4-dozen and 5-dozen size packs. When cost breakdowns are made, it is on a per-crate basis regardless of the type of pack. The same rule applies to 2- and 2½-dozen packs (in cartons or half crates). This report follows the above practice; a full crate cost is for a 4-dozen or 5-dozen pack, carton cost is for a 2- or 2½-dozen pack.

### Field Dry-Packing of Cartons

The predominant method of dry-packing lettuce in the field at the time of this study was in cartons, packed with 2 or 2½ dozen heads each, vacuum-cooled, and loaded in cars without top ice. Field-packed cartons are trucked by the grower or shipper directly from the field to the vacuum-cooling plants, which are centrally located on rail sidings at various points in each producing district. The vacuum-cooling company unloads the incoming trucks and after the cartons have been cooled loads them into refrigerator cars at the plant. The costs of these unloading and loading operations are included in the vacuum-cooling charge paid by the shipper to the cooling company. The cars are bunker-iced and are usually shipped under standard refrigeration, either half-stage or full bunker. Up to 2 percent salt is also often used. Costs for this method of packing were also obtained in both areas.

### Comparative Costs of Packing Methods

A questionnaire dealing with selected operating costs and shipping methods was mailed to nearly all lettuce producers and shippers in both the Salinas-Watsonville and the Imperial Valley-Arizona areas, a total of about 100. This blanket inquiry yielded about a 95-percent response. A sample, stratified by type of operation and by business volume, was drawn from the completed questionnaires, and random samples were in turn drawn from within each bracket. The information contained in the selected questionnaires was subsequently verified and supplemented by personal interviews. The sample, therefore, reflects the costs of proportionately more of the large producers but only because lettuce growing and shipping is essentially a large-scale operation.

Comparative full costs <sup>3/</sup> for field dry-packing of lettuce in cartons and for shed-packing of lettuce with ice in the WGA wood crates in the Arizona and Imperial Valley area are shown in figure 14. Similar data for both containers and packing methods in the Salinas-Watsonville area are presented in figure 15. Because shippers in the sample varied in the way they allocated the costs of certain component operations, these cost data lend themselves to only a few restricted comparisons. The costs shown in these figures for field-packing of cartons are for 2 cartons containing the same quantity of lettuce as 1 WGA crate.

The cost comparisons shown in figures 14 and 15 reveal that in both producing areas the total costs of harvesting, field-packing, vacuum-cooling, and loading the same quantity of lettuce in fiberboard cartons averaged lower than the costs of harvesting, shed-packing, and loading the commodity with ice in WGA crates. In the Salinas-Watsonville area the cost for harvesting, packing, cooling, and loading 2 cartons averaged \$1.70 for 4 shippers and in the Arizona-Imperial Valley area the costs of this method for 8 shippers averaged \$1.83. These figures compare with an average cost for shed-packing with ice and WGA crates of \$2.20 for 13 shippers in the Salinas-Watsonville area and \$2.15 for 12 shippers in the Arizona-Imperial Valley area. The average cost of shed-packing lettuce in wooden WGA crates with ice exceeded the average cost of field-packing in fiberboard cartons by \$0.50 or 29.4 percent in the Salinas-Watsonville district and by \$0.32 or 17.5 percent in the Arizona-Imperial Valley districts.

In both producing districts the largest cost category for shed-packing WGA crates was the packing and shed-operating expenses. This group of costs, which includes charges for labor, materials, and facilities used in trimming, packing, lidding, and loading the commodity, accounted for 73.6 percent of the total costs in the Salinas-Watsonville area and 74.4 percent of the total in the Arizona-Imperial Valley district. Harvesting costs for shed-packing comprised 17.3 percent of the total costs in the Salinas-Watsonville area and 17.2 percent in the Arizona-Imperial Valley area. The remaining 9.1 percent of the total cost in the Salinas-Watsonville district and 8.4 percent in the Arizona-Imperial Valley area represent administrative and selling expenses.

For the field-packed lettuce in cartons, figures 14 and 15 show that the largest group of costs was that covering vacuum-cooling and materials and supplies (including the cartons). In the Arizona-Imperial Valley district this group of costs accounted for 44.8 percent of the total costs, and in the Salinas-Watsonville area it comprised 48.8 percent of the total. The cost of harvesting and packing the cartons in the field was 43.2 percent of the total costs in the Arizona-Imperial Valley district and 37.1 percent in the Salinas-Watsonville area. Administrative and selling expenses accounted for larger percentages of the total costs for cartons in both areas than for shed-packing of wooden crates, the percentages being 12.0 percent for Arizona-Imperial Valley district and 14.1 percent for the Salinas-Watsonville area.

There were also substantial differences in packing costs between individual shippers, and also between the two main producing areas. This was particularly true of field dry-packing of the cartons. The differences cannot be entirely accounted for, but it is recognized that there are a number of factors affecting these costs. Probably the more important is the type of harvesting and field packing operation employed, but other conditions such as the density of harvest, quality of the lettuce, amount of trimming performed, the pace

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<sup>3/</sup> All costs incurred in getting the commodity from field into the railroad car for shipment, including taxes, insurance, depreciation, labor, supervision, charges for all equipment, facilities, materials, and supplies.

# LETTUCE HARVESTING, PACKING AND COOLING COSTS, IMPERIAL VALLEY - ARIZONA AREA, 1952

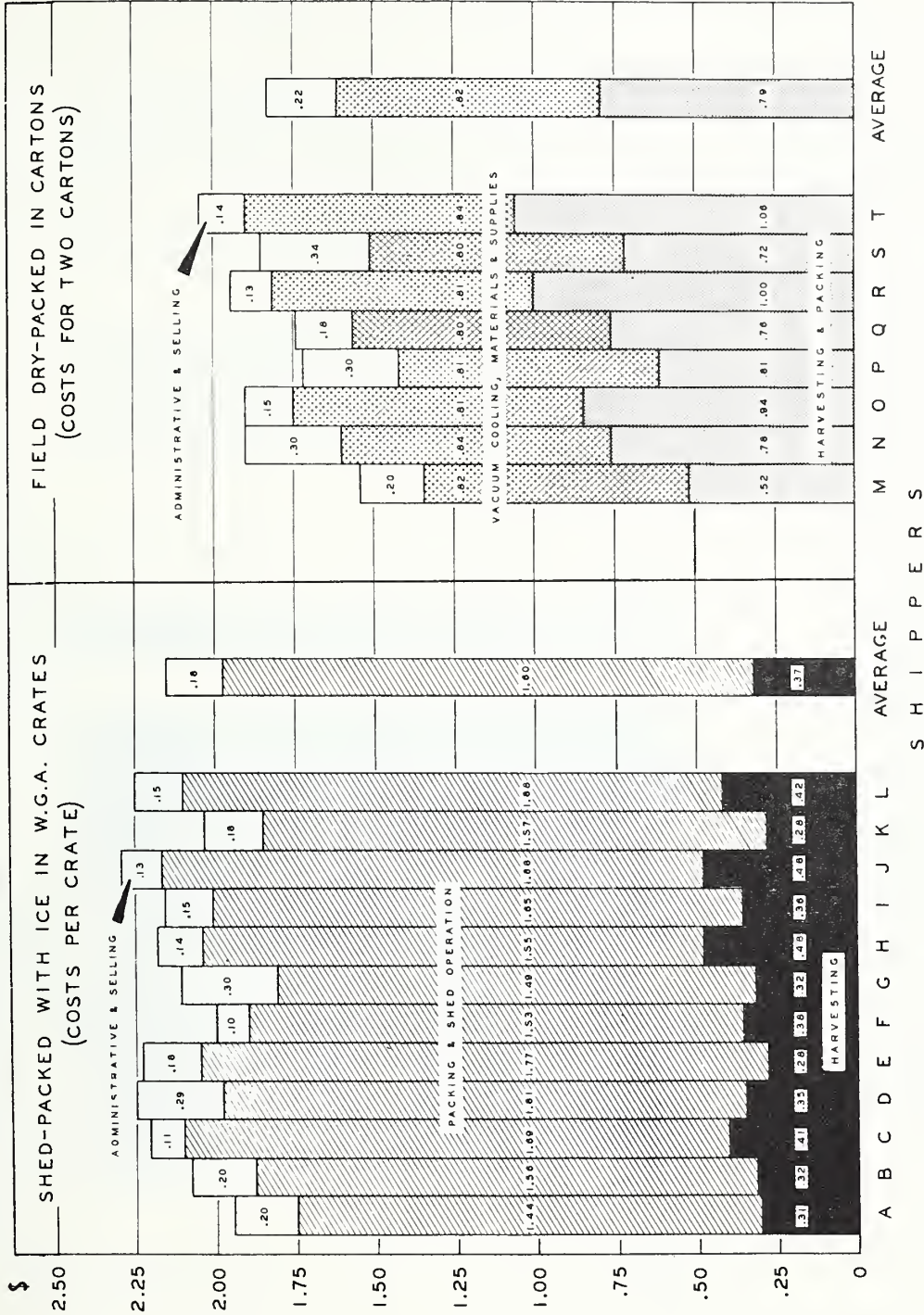


Figure 14.--Comparative costs to shippers of harvesting, packing, cooling, and loading lettuce shed-packed with ice in WGA crates and field dry-packed in fiberboard cartons, Imperial Valley, California, and southwestern Arizona area, 1952.

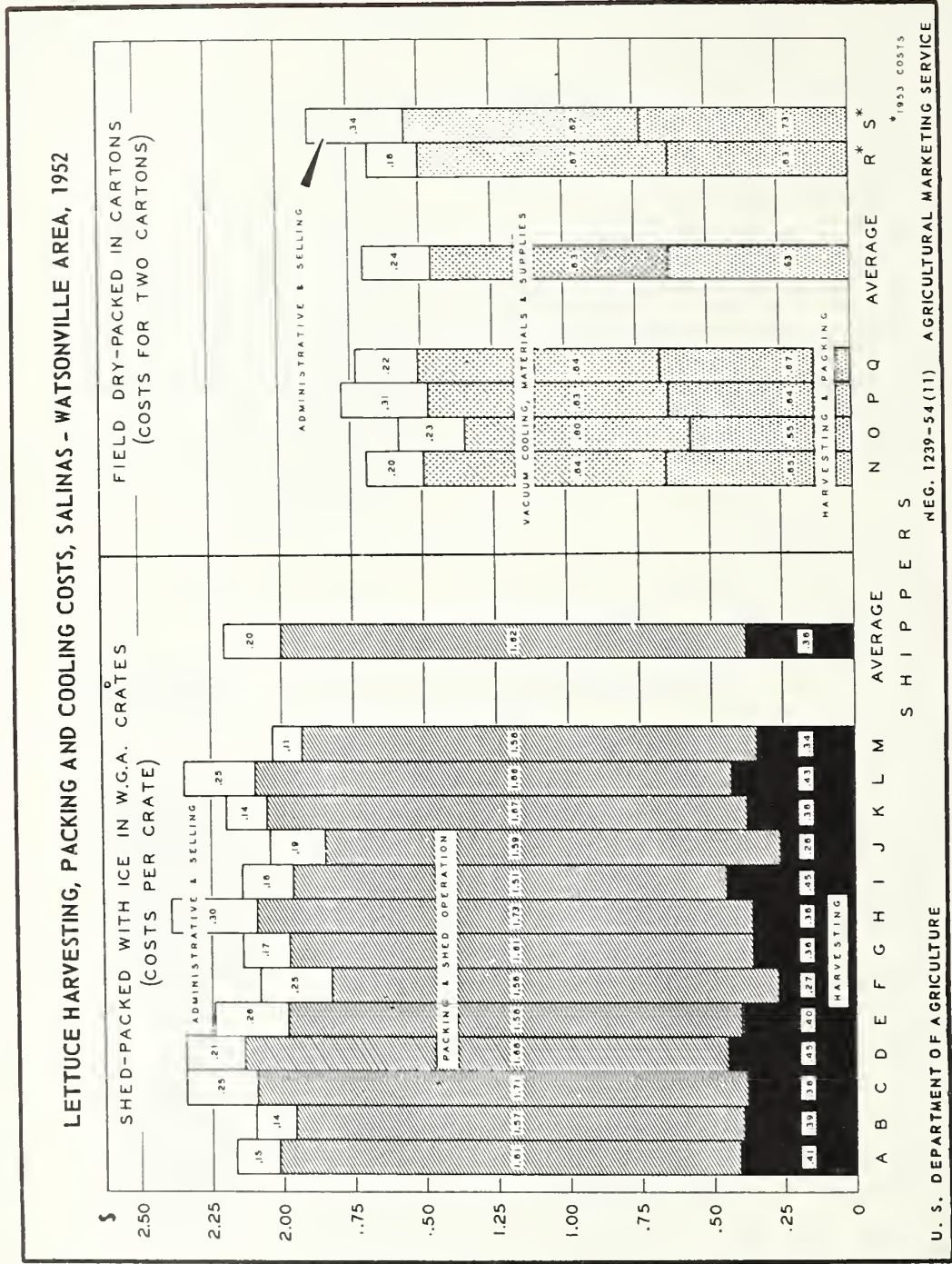


Figure 15.--Comparative costs to shippers of harvesting, packing, cooling, and loading lettuce shed-packed with ice in WCA crates and field dry-packed in fiberboard cartons, Salinas-Watsonville area, California, 1952.

of the packing crews, the quality of field supervision and the location of the fields in relation to the vacuum-cooling plants are also important.

### Dry-Packing of Cartons in the Shed

There was some dry-packing of cartons in packing sheds in both the desert districts and Salinas-Watsonville area during the 1952-53 season. After the lettuce was packed it was hauled to a vacuum-cooling plant for cooling and loading into cars.

The average cost of dry-packing in the shed may be approximated by eliminating labor, materials, and other costs incident to packing lettuce in standard crates and substituting costs incident to the packing and handling of cartons in the shed. The adjustment for cost of labor, based upon contract wage scales in the respective districts, is shown in table 2.

Table 2.--Cost of dry-packing lettuce in cartons in packing sheds, by items, Imperial Valley-Arizona and Salinas-Watsonville areas, 1952

Item	Imperial Valley- Arizona Dollars	Salinas- Watsonville Dollars
Cost		
Harvesting . . . . .	0.1829	0.1871
Packing and shed expenses:		
Materials. . . . .	.2562	.2621
Cull hauling . . . . .	.0098	.0066
Supervision. . . . .	.0149	.0128
Labor		
Cost per crate . . . . .	-	.5481
Average WGA cost . . . . .	.5037	-
Deductions . . . . .	-	.1128
Packer, ladder, etc. . . . .	.1128	-
Pad man, ice blower, labeler . . . .	.0613	.0613
Total deductions . . . . .	.1741	.1741
Total labor cost per crate	.3296	.3740
Cost per carton 1/ . . . . .	.1648	.1870
Additions		
Packer . . . . .	.0450	.0450
Flap folder. . . . .	.0084	.0084
Ladder . . . . .	.0100	.0100
Total additions. . . . .	.0634	.0634
Total labor cost per carton. . . . .	.2282	.2504
Other direct costs . . . . .	.0491	.0298
Total packing and shed expense . . . .	.5546	.5604
Hauling cartons to cooling plant . . . . .	.0225	.0225
General overhead. . . . .	.0888	.1001
Vacuum-cooling charge 2/ . . . . .	.1500	.1500
Total cost per carton. . . . .	.9988	1.0201

1/ Cost of labor per crate adjusted to carton basis by dividing by 2.

2/ Includes unloading incoming trucks and loading cartons in refrigerator cars.

The total cost for shed-packed cartons vacuum-cooled is \$1.00 for the Imperial Valley-Arizona area and \$1.02 for the Salinas-Watsonville area. In order to put these costs per carton on a comparable basis with those shown in figures 14 and 15 for 4 or 5 dozen heads in WGA crates and for 2 cartons packed in the field, it is necessary to double them, making them \$2.00 and \$2.04 for the Imperial Valley-Arizona and Salinas-Watsonville areas, respectively.

If the cartons, instead of being vacuum-cooled, were fan-precooled (as some Imperial Valley-Arizona shippers do), the costs would be altered slightly. A fan-precooling charge of \$15.00 per car would be substituted for the vacuum-cooling charge, and a later cost for loading would be added.

	Imperial Valley- Arizona <u>Dollars</u>
Dry-pack costs for a vacuum-cooled carton	1.0024
Deduct vacuum-cooling charge and hauling cost to vacuum-cooling plant	<u>.1725</u>
Remaining cost	.8299
Add labor for loading	.0132
Add fan-precooling charge (\$15.00 per car and 640 cartons)	<u>.0234</u>
Total cost for carton	.8665

#### Field Dry-Packed Cartons Fan-Cooled in Refrigerator Cars

In the 1952-53 winter deal in the desert areas of California and Arizona, some shipments were fan-cooled instead of vacuum-cooled. The costs for this variation would be the same as for the vacuum-cooled carton costs (shown on page 22), with a few exceptions.

	Imperial Valley- Arizona <u>Dollars</u>
Costs for vacuum-cooled field-packed cartons	0.9141
Deduct vacuum-cooling charge	<u>.1500</u>
Remaining cost	.7641
Add fan-cooling cost (\$15.00 per car and 640 cartons per car)	.0234
Add labor for loading	<u>.0132</u>
Total carton cost	.8007
Costs for two cartons (4 or 5 dozen heads)	1.60

The above costs assume that no stripping is used between layers of cartons in the car. No standard procedure has been developed in this regard; some shippers use strips

to facilitate faster cooling of the lettuce, and others do not use them. Therefore, the cost per carton, field dry-packed and fan-cooled, but without stripping, would be \$0.80.

### Dry-Packing WGA Crates in the Field

When the vacuum-cooling process for lettuce was first introduced, a substantial quantity was vacuum-cooled in WGA crates dry-packed in the field. There is still some lettuce packed and cooled in this manner, although the practice is not as widespread as formerly. No shipper cost data have been developed for this packing method, but an estimate can be made based on the field dry-pack costs of shippers who use cartons.

The compilation shown in table 3 assumes that harvesting, hauling, and other direct costs would be twice as much for WGA crates as for cartons. Some shippers having experience with both types of containers use this general ratio when estimating their costs. Thus, the total cost for a WGA crate that was field dry-packed and vacuum-cooled was \$1.94 (Imperial Valley-Arizona) or \$1.76 (Salinas-Watsonville).

Table 3.--Estimated cost of dry-packing lettuce in WGA crates in the field, 1952 season

Item	Imperial Valley- Arizona	Salinas- Watsonville
	<u>Dollars</u>	<u>Dollars</u>
Cost--		
Per carton:		
Harvesting, packing, hauling, and other		
direct costs . . . . .	0.400	0.314
General overhead. . . . .	.110	.121
Total . . . . .	.510	.435
Per crate 1/:	1.020	.870
Additions:		
WGA crate component . . . . .	.669	.637
Vacuum-cooling charge . . . . .	.250	.250
Total cost per crate. . . . .	1.939	1.757

1/ Cost per carton adjusted to crate basis by multiplying by 2.

### Summary of Packing Costs

In order to permit a direct comparison of costs of different methods of packing and cooling, the information presented in previous sections of this report is summarized in table 4. Costs are expressed also on a 4- and 5-dozen pack basis, in order to equalize the basis of comparison between crates and cartons.

Table 4.--Cost of harvesting, packing, cooling, and loading lettuce, by type of container, Imperial Valley, Arizona and Salinas-Watsonville, Calif., 1952

Type of container and method of packing and cooling	Per container		Per 4- and 5-dozen heads	
	Imperial	Salinas-	Imperial	Salinas-
	Valley-	Watson-	Valley-	Watson-
	Arizona	ville	Arizona	ville
	<u>Dollars</u>	<u>Dollars</u>	<u>Dollars</u>	<u>Dollars</u>
Crate, WGA:				
Shed-packed with ice . . . . .	2.15	2.20	2.15	2.20
Field dry-packed, vacuum-cooled. . . . .	1.94	1.76	1.94	1.76
Carton, dry-packed:				
Field:				
Vacuum-cooled. . . . .	.91	.85	1.83	1.70
Fan-cooled . . . . .	.80	-	1.60	-
Shed:				
Vacuum-cooled. . . . .	1.00	1.02	2.00	2.04
Fan-cooled . . . . .	.87	-	1.74	-

## TRANSPORTATION AND REFRIGERATION CHARGES

Previous sections of this study have shown costs for various methods of packing lettuce. These compilations covered all costs from the time the lettuce was first cut in the field until it was packed in containers and loaded into refrigerator cars. However, the final cost figure, which is most important, is the cost of a container delivered in a destination market. Two markets--New York, N. Y., and St. Louis, Mo.--were selected as representative of a large proportion of destination markets. New York City is one of the longest haul markets from the West Coast, and St. Louis is a typical midwestern market from the standpoint of transportation costs.

Tables 5 and 6 show the freight and refrigeration charges for various types of containers and methods of packing. The costs are projected to a container basis for the most common load and the most commonly used protective service. Table 5 shows costs from El Centro to New York City and to St. Louis. Table 6 shows costs from Salinas to New York City and St. Louis.

There is some variation in the type of protective refrigeration service that individual shippers use. Services also vary with the season of the year. The number of containers loaded in a car varies slightly from shipper to shipper and between shipping areas. The data in the tables were based upon the practice generally prevailing in each district when the study was made.

Total transportation and refrigeration charges for lettuce shipped from both major producing areas in crates and cartons packed and cooled by different methods are summarized in table 7. The information is shown on a per container basis and for an equivalent quantity of lettuce on a 4- or 5-dozen pack basis. This comparison reveals that total

Table 5.--Freight and refrigeration charges per container for lettuce shipped from El Centro, Calif., to New York City and St. Louis, by type of container and method of refrigeration, 1952 1/

Type of container and method of refrigeration	Containers per load	Charge per container from El Centro, Calif., to-	
		New York City	St. Louis
	Number	Dollars	Dollars
Crates, WGA:			
Ice-packed, dry bunkers, 20,000 pounds top ice . . . .	337	1.94	1.60
Dry-pack, vacuum-cooled, pre- iced bunkers, half-stage standard refrigeration . . . .	326	2.09	1.72
Cartons, dry-pack; vacuum- cooled, pre-iced bunkers, half-stage standard refrig- eration . . . . .	640	1.01	.83

1/ Explanation of weights and rates used to determine above charges: Billing weights of containers: 78 pounds for WGA crate; 37½ pounds for cartons. Freight rate per hundred-weight: \$2.28 to New York City; \$1.87 to St. Louis. 20,000 pounds top-ice refrigeration charges: \$34.39 to New York City; \$30.42 to St. Louis. Half-stage standard refrigeration charges: \$82.66 to New York City; \$69.44 to St. Louis. U. S. Federal tax: 3 percent tax included in above charges per container.

transportation and refrigeration costs for the same quantity of lettuce shipped in dry-packed cartons are greater than for shipments of the ice-packed WGA crate. The differences are greater in favor of shipments from El Centro in the Imperial Valley to both eastern markets than for shipments from the Salinas-Watsonville area. It is also to be noted that the total freight and refrigeration charges for lettuce dry-packed in WGA crates exceed the costs for shipping the same quantity of lettuce dry-packed in cartons or ice-packed in WGA crates.

The differences in total shipping costs revealed here are due largely to differences in the costs of refrigeration used for the lettuce packed by different methods since the freight rate is the same for a given quantity of the commodity shipped from the same shipping point to the same destination. The tare weight of the container, particularly dry-packed WGA crates, also accounts for part of the difference in total shipping costs. However, part of the cost advantage gained by dry-packing fiberboard cartons in the field or shed, or in dry-packing WGA crates in the field, is lost in shipping because of the higher aggregate transportation costs.

Table 6.--Freight and refrigeration charges by container for lettuce shipped from Salinas, Calif., to New York City and St. Louis, by type of container and method of refrigeration, 1952 <sup>1/</sup>

Type of container and method of refrigeration	Containers per load	Charge per container from El Centro, Calif., to-	
		New York City	St. Louis
	Number	Dollars	Dollars
Crates, WGA:			
Ice-packed, initial bunker ice, 20,000 pounds top ice .	328	2.15	1.80
Dry-pack, vacuum-cooled, pre- iced bunkers, full-stage standard refrigeration with 2 percent salt . . . . .	326	2.27	1.87
Cartons, dry-pack; vacuum- cooled, pre-iced bunkers, full-stage standard refrig- eration with 2 percent salt .	640	1.10	.91

<sup>1/</sup> Explanation of weights and rates used to determine above charges: Billing weights of containers: 78 pounds for WGA crate; 37½ pounds for cartons. Freight rate per hundred-weight: \$2.38 to New York City; \$1.97 to St. Louis. 20,000 pounds top ice refrigeration charges: \$34.39 to New York City; \$30.42 to St. Louis. Full-stage standard refrigeration charges: \$105.80 to New York City; \$88.61 to St. Louis. 2 percent salt charge: 5 percent of full-stage standard refrigeration charge. Initial bunker ice: \$21.16 to New York City; \$17.19 to St. Louis. Cost of bunker ice is \$21.21 (based on average bunker capacity of 10,500 pounds per car and \$4.04 per ton ice cost) and 60 cents switching charge. U. S. Federal tax: 3 percent tax included in above charge per container.

Table 7.--Transportation and refrigeration costs per container for rail shipments of lettuce from El Centro, and Salinas, Calif., to New York City and to St. Louis, by type of container and method of packing and cooling, 1952

Type of container, and method of packing and cooling	From El Centro, Calif. to:				From Salinas, Calif. to:			
	New York, N. Y. :		St. Louis, Mo. :		New York, N. Y. :		St. Louis, Mo. :	
	Per	Per 4 or	Per	Per 4 or	Per	Per 4 or	Per	Per 4 or
	container:	5 dozen	container:	5 dozen	container:	5 dozen	container:	5 dozen
	heads	heads	heads	heads	heads	heads	heads	heads
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Crate, WGA:								
Shed-packed with ice . . . . .	1.94	1.94	1.60	1.60	2.15	2.15	1.80	1.80
Field dry-packed, vacuum- cooled . . . . .	2.09	2.09	1.72	1.72	2.27	2.27	1.87	1.87
Carton, dry-packed:								
Field:								
Vacuum-cooled . . . . .	1.01	2.02	.83	1.66	1.10	2.20	.91	1.82
Fan-cooled . . . . .	1.01	2.02	.83	1.66	-	-	-	-
Shed:								
Vacuum-cooled . . . . .	1.01	2.02	.83	1.66	-	-	-	-
Fan-cooled . . . . .	1.01	2.02	.83	1.66	-	-	-	-

## TOTAL COSTS OF HARVESTING, PACKING, AND SHIPPING

The total costs of harvesting, packing, transportation, and refrigeration by type of container and method of packing and cooling for lettuce shipped from both producing areas to New York and St. Louis are given in table 8. These costs are the totals of the harvesting, packing, cooling, and loading costs previously presented in table 4 and the transportation and refrigeration charges summarized in table 7.

Table 8.--Packing, loading, transportation, and refrigeration costs per container for rail shipments of lettuce from El Centro and Salinas, Calif., to New York City and St. Louis, by type of container and method of cooling, 1952

Type of container and method of packing and cooling	From El Centro, Calif., to:				From Salinas, Calif., to:			
	New York, N. Y.		St. Louis, Mo.		New York, N. Y.		St. Louis, Mo.	
	Per	Per 4 or	Per	Per 4 or	Per	Per 4 or	Per	Per 4 or
	container:	5 dozen	container:	5 dozen	container:	5 dozen	container:	5 dozen
	heads	heads	heads	heads	heads	heads	heads	heads
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Crate, WGA:								
Shed-packed with ice . . . . .	4.09	4.09	3.75	3.75	4.35	4.35	4.00	4.00
Field dry-packed, vacuum-cooled. . .	4.03	4.03	3.66	3.66	4.03	4.03	3.63	3.63
Carton, dry-packed:								
Field:								
Vacuum-cooled . . . . .	1.92	3.84	1.74	3.48	1.95	3.90	1.76	3.52
Fan-cooled. . . . .	1.81	3.62	1.63	3.26				
Shed:								
Vacuum-cooled . . . . .	2.01	4.02	1.83	3.66	2.12	4.24	1.93	3.86
Fan-cooled. . . . .	1.88	3.76	1.70	3.40				

Although part of the savings from dry-packing lettuce in fiberboard cartons in the field or shed or dry-packing WGA crates in the field as compared with ice-packing WGA crates in packing sheds is absorbed by increased refrigeration costs, there remains a fairly substantial net saving in the overall cost of getting the lettuce from the field to the destination market by several of the dry-packing methods. For the same quantity of lettuce (4 or 5 dozen heads) the overall net saving of using fiberboard cartons dry-packed in the field and vacuum-cooled for shipments from the Imperial Valley area to New York as compared with WGA crates ice-packed in the shed was 25 cents, or approximately \$80.00 per car. For shipments from El Centro to St. Louis, the comparable saving is 27 cents per 4 or 5 dozen heads, or \$86.40 per car. The net savings in overall costs of harvesting, packing, cooling, and shipping the lettuce from the two major producing areas to New York and St. Louis for the dry-packing method as compared with ice-packing WGA crates in the shed are summarized in table 9.

Table 9.--Net savings of shipping lettuce dry-packed in fiberboard cartons in field and in packing sheds and WGA crates dry-packed in field as compared with WGA crates ice-packed in shed, 1952

Type of container and method of packing	From El Centro, Calif., to-				From Salinas, Calif., to-			
	New York, N. Y.		St. Louis, Mo.		New York, N. Y.		St. Louis, Mo.	
	Per 4 or	Per	Per 4 or	Per	Per 4 or	Per	Per 4 or	Per
	5 dozen	carload	5 dozen	carload	5 dozen	carload	5 dozen	carload
	heads		heads		heads		heads	
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Crates, WGA, dry-packed in field, vacuum-cooled . . .	0.06	19.20	0.09	28.80	0.32	102.40	0.37	118.40
Cartons, fiberboard, dry-packed:								
Field:								
Vacuum-cooled . . . .	.25	80.00	.27	86.40	.45	144.00	.48	153.60
Car fan-cooled. . . .	.47	150.40	.49	156.80				
Shed:								
Vacuum-cooled . . . .	.07	22.40	.09	28.80	.11	35.20	.14	44.80
Car fan-cooled. . . .	.33	105.60	.35	112.00				

## LETTUCE BRUISING AND DECAY IN CARTONS AND CRATES

In addition to the relative costs of each method of packing and shipping lettuce, another important factor in evaluating the different packing methods is the comparative amount of salable commodity delivered at the wholesale and retail levels in destination markets. To afford a comparison of the bruising and decay to lettuce dry-packed in cartons and ice-packed in wooden crates, 13 transportation tests were made--8 from the Imperial Valley during January and February 1953, and 5 from the Salinas area in May and June 1953.

### Test Procedure

In each test, 3 WGA crates and 6 No. 7300-type cartons were packed from a common lot of 4-dozen size lettuce <sup>4</sup>/<sub>4</sub>. The test containers were packed by men skilled in the packing of each type of container. The usual amount of package ice, approximately 30 pounds, was placed in the crates. After packing, they were tagged and loaded in a doorway position in a carload of WGA crates. When the loading was completed, the car was top-iced in the customary way. In addition, bunkers of cars containing test crates from the Salinas area in May and June were initially iced.

After packing, the test cartons were hauled to a plant where they were also loaded in a doorway position in a carload of carton lettuce moving under half-stage or full-bunker standard refrigeration. Test cars from the Imperial Valley during the winter months received half-stage bunker ice and those from the Salinas area in May and June were under full-bunker standard refrigeration, generally with 1 or 2 percent salt.

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<sup>4</sup>/<sub>4</sub> A relatively small amount of 5-dozen size lettuce is shipped in cartons. The container used for 2½ dozen heads is No. 7301-X, ½-inch smaller than No. 7300 in depth and width, but 1 1/8-inch longer.

Both cars containing test packages were loaded at the same shipping point on the same day and moved to the same destination. Upon arrival and unloading of the pair of cars at the eastern destination, 1 test crate and 2 test cartons were inspected for bruising and decay. The remaining crates and cartons were held at room temperatures to simulate market-holding conditions. The temperatures at which test crates and cartons from the January and February tests were held for subsequent observation ranged from 55° to 80° F., averaging about 68° F., and those for the tests conducted during May and June 1953, ranged from 57° to 82° F., averaging approximately 74° F. After 24 hours an additional crate and 2 cartons were inspected, and after 48 hours the remaining crate and 2 cartons were examined. At all stages the lettuce was examined by official inspectors of the Department of Agriculture.

### Test Results

The percentages of condition defects found at each inspection for all tests are found in table 10. It will be noted that more bruising and decay were found in test shipments from the Salinas area, where the condition of the lettuce at the time of shipment was not as good as that shipped from the Imperial Valley in the winter. Further, it might be expected that transit refrigeration would be somewhat less efficient during the warmer months in which the Salinas tests were made than in the winter months when the tests from the Imperial Valley were run.

It is not the purpose of this comparison to establish average rates of commodity bruising and decay for dry-packed lettuce in fiberboard cartons and ice-packed lettuce in crates. The shipping experiments were not designed for that purpose. They were designed only for the purpose of obtaining an approximate measure of the comparative ability of the two methods of packing to deliver salable lettuce at the wholesale and retail levels. This information was required to supplement that on comparative packing and shipping costs presented in preceding sections of this report in order to round-out the overall comparison of both packing methods.

Both the percentages of heads damaged and seriously damaged by bruising and those affected by decay were greater in ice-packed crates than in vacuum-cooled cartons at the time of unloading, as well as after 1 and 2 days' storage under simulated market-holding conditions. For all 13 shipping tests from both major producing areas, 4.97 percent of the heads in the WGA crates were seriously damaged by bruising and decay upon arrival at terminal markets as compared with 1.60 percent of the heads in the fiberboard cartons. At the 24-hour inspection the total heads seriously damaged by bruising and decay had increased to 8.49 percent for the ice-packed WGA crates and 5.45 percent for the cartons. After 48 hours, 32.05 percent of the heads in the WGA crates and 17.15 percent of the heads in the cartons were seriously damaged by bruising and decay. It was noted that decay was more likely to develop on bruised areas than on undamaged portions of individual heads.

No comparison of the condition of dry-packed lettuce in wooden crates or field-packed fan-cooled lettuce in cartons was made.

It should be emphasized, as is explained in footnote 3 of table 10, that a head showing decay at time of inspection, even though it was also bruised, was removed from the *bruised* category and scored under *decay*. This is the reason that the average number of heads shown as bruised upon inspection after 48 hours is smaller in some instances than was found at the 24-hour inspection.

Table 10.--Condition of California lettuce shipped in ice-packed WGA crates and field dry-packed fiberboard cartons to selected eastern markets, upon arrival, 24-hours after arrival, and 48-hours after arrival, 1953 <sup>1/</sup>

Time of inspection at terminal market and type of container	Shipped from Imperial Valley - 8 tests					
	Heads : slightly : damaged : by bruising 2/ 3/ :			Heads : seriously bruised and decayed		
	Moderate : Serious : bruising : Decay : Total :			Percent		
	Percent	Percent	Percent	Percent	Percent	Percent
Upon arrival						
Cartons . . . . .	14.32	0.78	0.00	0.78	1.56	0.78
Crates. . . . .	30.99	4.69	0.52	0.26	5.47	0.78
After 24 hours						
Cartons . . . . .	9.90	1.04	0.26	1.82	3.12	2.09
Crates. . . . .	21.35	6.51	2.08	2.08	10.67	4.16
After 48 hours						
Cartons . . . . .	10.42	2.86	0.26	5.47	8.59	5.73
Crates. . . . .	11.98	10.42	2.60	6.25	19.27	8.85
	Shipped from Salinas - 5 tests					
Upon arrival						
Cartons . . . . .	15.00	0.00	0.00	2.92	2.92	2.92
Crates. . . . .	22.50	6.67	2.08	9.58	18.33	11.66
After 24 hours						
Cartons . . . . .	16.25	3.75	0.00	10.83	14.58	10.83
Crates. . . . .	20.42	12.50	3.33	12.08	27.91	15.41
After 48 hours						
Cartons . . . . .	18.75	3.75	0.00	35.42	39.17	35.42
Crates. . . . .	7.08	6.25	2.25	66.25	74.75	68.50
	Total - 13 tests					
Upon arrival						
Cartons . . . . .	14.58	0.48	0.00	1.60	2.08	1.60
Crates. . . . .	27.72	5.45	1.12	3.85	10.42	4.97
After 24 hours						
Cartons . . . . .	12.34	2.08	0.16	5.29	7.53	5.45
Crates. . . . .	20.99	8.81	2.56	5.93	17.30	8.49
After 48 hours						
Cartons . . . . .	13.62	3.21	0.16	16.99	20.36	17.15
Crates. . . . .	10.10	8.81	2.72	29.33	40.86	32.05

<sup>1/</sup> Shipped in ice-packed WGA crates and field dry-packed fiberboard cartons. Percentages are based on 48 heads in each type of container, each inspection and in each test.

<sup>2/</sup> The slight bruising classification includes all heads with 1 or more leaves of the compact portion of the heads affected by bruising and not enough leaves affected to be considered damaged according to U. S. standards for head lettuce.

<sup>3/</sup> The average percentages shown in each classification of bruising injury do not include bruised heads which were also affected by decay. In many cases it would have been impossible to determine degree of bruising on decayed heads.

The last column of table 10 shows the percentage of heads in each type of pack at each inspection that were decayed or so seriously damaged by bruising as to be considered unmarketable.

If 4 dozen heads of lettuce free from defects were worth \$7 on the wholesale market, the percentages of seriously damaged heads found in the transportation tests would reflect the losses in the value of the commodity shown in table 11.

Table 11.--Loss by seriously damaged heads of lettuce found in transportation tests, May and June, 1953

Type of container	Loss at time of inspection					
	On arrival		After 24 hours		After 48 hours	
	Percentage	Value	Percentage	Value	Percentage	Value
	Percent	Dollars	Percent	Dollars	Percent	Dollars
Cartons . . . . .	1.60	0.10	5.45	0.39	17.15	1.20
Crates. . . . .	4.97	0.35	8.49	0.60	32.05	2.24

No study was made of the average temperatures and length of storage to which lettuce is actually subjected under the widely varying conditions that would be found in various markets, at various wholesale houses or warehouses, and under different conditions of handling to retail stores. Consequently, the selection of the 24- and 48-hour holding periods at these temperatures was arbitrary. Lettuce trucked directly from the railroad car to the retail store may reach the home refrigerator in less than 12 hours. However, under other distributive conditions it may be exposed to less favorable conditions of temperature and humidity than those imposed under the 48-hour holding test. The purpose of these tests was to compare the effect on lettuce of the two methods of packing, under the same range of conditions.

## CONCLUSIONS

Analysis of data on the cost of different methods of harvesting and packing lettuce in the major producing districts of California and Arizona disclosed that dry-packing of fiberboard cartons in the field was the lowest-cost method of harvesting and packing the commodity for shipment. The data revealed that it cost from 17 to 34 cents more per 4 or 5 dozen heads to dry-pack fiberboard cartons in packing sheds than to dry-pack them in the field.

The most economical method of packing and cooling the lettuce for shipment was found to be packing in field dry-packed fiberboard cartons, fan-cooled in bunker-iced refrigerator cars prior to shipment. This method, however, was used only during the winter months in the desert areas of southern California and Arizona where the early morning temperature of the lettuce at time of harvest is comparatively low.

Although part of the savings in packing, handling, and container costs realized by dry-packing fiberboard cartons in the field or shed and in dry-packing WGA crates in the

field as compared with ice-packing of WGA crates in packing sheds is absorbed by the increased cost of refrigeration required by the dry-packed commodity in transit, the net saving in getting the commodity from the field to terminal market by several of the dry-packing methods is substantial. On shipments from El Centro, Calif., to New York, N. Y., for example, the saving on field dry-packed fiberboard cartons, vacuum-cooled, compared with ice-packed WGA crates, amounted to 25 cents per 4 or 5 dozen heads, or \$150.40 per car. The most important economies of dry-packing fiberboard cartons in the field compared with ice-packing WGA crates in packing sheds resulted from lower labor cost for packing, handling, and loading, lower costs of containers and container components, and lower overhead costs for facilities and equipment.

Shipping and storage tests conducted during the winter and spring of 1953 disclosed that the lettuce dry-packed in fiberboard cartons in the field and vacuum-cooled suffered less serious damage and decay in transit than ice-packed lettuce in WGA crates. The same relationship may not prevail between the two packing methods in shipments made during the warm summer months. The studies of the arrival condition of lettuce did not include dry-packed lettuce which was fan-precooled in the car before shipment.



